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REENGINEERING THE AIR OPERATIONS CENTER

by

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14. ABSTRACT
A research topic submitted by HQ PACAF/XP formed the basis of this research project. Their submittal requested a study into the Air Operations Center (AOC) of the future. This paper applies business reengineering techniques to develop and evaluate conceptual models for the AOC of the future. As opposed to seeking incremental process improvement through technology, business reengineering seeks radical improvement by discarding previously held assumptions and developing new organization and process structures. This approach was applied to define conceptual models for the AOC of the future. The first step entailed development of a vision, or end state, which described core mission environment requirements. This end state shaped the criteria for evaluating the current AOC model. The second step required selection of reengineering enablers that formed the basis of the model redesign. Through challenging the current paradigm for airpower command and control and leveraging technology, two models are proposed?a decentralized model and a centralized model. Finally, both proposed models were assessed using the AOC end state criteria. Although neither model fully complied with the desired end state criteria, both models posit a threefold improvement over today?s AOC model. Given these results, further efforts to reengineer the AOC may offer the best path for realizing the AOC of the future.

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Preface

Of the many fascinating topics in the Air University database, HQ PACAF's submittal on the Air Operations Center (AOC) of the future presented some challenges that interested me. At first, I took the typical "techie" approach and was ready to investigate and recommend new technologies to help the AOC do what it does better and faster. As I became familiar with the AOC and its processes, I concluded that this research problem was well suited for business reengineering. First, the evolution of the AOC from our airpower command and control doctrine offered an opportunity to challenge assumptions flowing from that doctrine. Second, current and emerging technologies applicable to the AOC are enabling significant redrawing of organizational structures and processes throughout the business community. To me, these signaled that the AOC was ripe for reengineering.

I want to thank my faculty research advisor, Maj Andrew Hall, for his insightful guidance. As I thrashed about, he provided a calming influence and kept me focused. He was always prepared to be my sounding board for ideas, gave me latitude to explore different paths and direction to keep me in the right part of the universe.

Lastly, and of highest importance, my thanks to my wife (and editor), Marsha, and my daughter, Kaitlin, for their ceaseless patience and support of my career. They are my world.

Abstract

A research topic submitted by HQ PACAF/XP formed the basis of this research project. Their submittal requested a study into the Air Operations Center (AOC) of the future. This paper applies business reengineering techniques to develop and evaluate conceptual models for the AOC of the future.

As opposed to seeking incremental process improvement through technology, business reengineering seeks radical improvement by discarding previously held assumptions and developing new organization and process structures. This approach was applied to define conceptual models for the AOC of the future. The first step entailed development of a vision, or end state, which described core mission environment requirements. This end state shaped the criteria for evaluating the current AOC model. The second step required selection of reengineering enablers that formed the basis of the model redesign. Through challenging the current paradigm for airpower command and control and leveraging technology, two models are proposed—a decentralized model and a centralized model. Finally, both proposed models were assessed using the AOC end state criteria.

Although neither model fully complied with the desired end state criteria, both models posit a threefold improvement over today's AOC model. Given these results, further efforts to reengineer the AOC may offer the best path for realizing the AOC of the future.

Chapter 1

Introduction

This generation may be the one that will face Armageddon.

—Ronald Reagan

There seems to be at least one point of reference on which futurists and strategists agree—tomorrow's world will not be like yesterday's world. Yesterday, we saw a bipolar world and technological improvement. Today, we see geopolitical instability and orders of magnitude growth in technology. Tomorrow *may* bring geopolitical chaos and cosmic leaps in technology. By definition, there is not certainty in predicting the future. Nevertheless, the future will come whether it is planned for or not.

Many of the research topics submitted to Air University for the 1998 academic year demonstrate a commitment to planning for the future. Generally, these topics ask for assessment, analysis, and recommendations based on the predicted future in a variety of areas. One of these suggested topics, submitted by HQ PACAF/XP, formed the basis of this research project. Their submittal requested a study into the Air Operations Center (AOC) of the future. Specifically, they requested the study address "the issues of deployability, size, and asset usage…blend[ing] these three major issues into a homogenous whole that allows the AOC of the future to effectively perform its air and space mission throughout the global arena."[1] To fully meet this request, an architecture combining the operational and system views is needed. Unfortunately, a complete architecture description is well beyond the scope of this paper. Instead, this paper lays the foundation by applying business reengineering techniques to develop and evaluate conceptual models for the AOC of the future.

Research Approach

The chosen research approach is to first define a desired end state for the AOC. This end state describes the core mission environment characteristics required of the AOC of the future. Therefore, it becomes the *to-be* state. Once an end state is defined, today's AOC, the *as-is* state, is analyzed for short falls. Next, business reengineering principles are employed to select key change enablers to enhance redesign of the AOC. By leveraging these change enablers, two models are defined and assessed for short falls using the AOC of the future end state criteria.

Business Reengineering

Why does the selected research approach adapt business reengineering principles? First, it is the law. In accordance with the Information Technology Management Reform Act of 1996 and the implementing Executive Order 13011, business reengineering approaches *must* be undertaken *before* "investing in information technology to support that work."[2] Second, it is because business reengineering may lead to the best model for the AOC of the future. As described by one Air Force agency, business reengineering is

> The fundamental re-thinking and radical redesign of business processes to achieve dramatic improvement in critical, contemporary measures of performance, such as cost, quality, service, and speed. Seeks breakthroughs, not by enhancing existing processes, but by discarding and replacing them with entirely new ones.[3]

The original advocates for business reengineering are Hammer and Champy. They are credited with coining the phrase "business reengineering"[4] to describe a technique they developed in which corporations can "reinvent" themselves. They define the term "reengineering" as "the fundamental rethinking and radical redesign of business processes to achieve dramatic improvement in critical, contemporary measures of performance."[5] In their words, "Reengineering is about beginning again. It is about rejecting the conventional wisdom and received assumptions of the past. Reengineering is about inventing new approaches to process structures that bear little or no resemblance to those of previous eras."[6] In short, it is starting with a clean slate.

As opposed to the 10 to 20 percent gains claimed by other process improvement methodologies, advocates of business reengineering claim corporations realize improvements from as little as 50 percent to as much as orders of magnitude.[7] Already, several Fortune 500 companies have successfully implemented reengineering strategies to dramatically improve their processes. Using reengineering strategies, IBM reduced its credit application processing from seven days to four hours; Ford downsized its vendor invoice processing organization from 500 people to 125 people; and Kodak cut its design-to-production cycle in half—to 38 weeks.[8] These represent just a small sampling of numerous business reengineering success stories.

Assumptions/Constraints

This research project assumes the "process" to be redesigned is the AOC. Where most business reengineering strategies adopt team approaches comprised of various process owners and a senior leader, this research project is an individual effort. Therefore, it is an academic exercise to demonstrate the possibilities of business reengineering principles applied to an Air Force problem. Additionally, conclusions are derived from unclassified sources. Consequently, if there are classified requirements of the AOC, they were not reviewed for their impact. Finally, the "AOC of the future" referred to in this research paper is the AOC which is an integrated component of the US Air Force's combat air operations command and control system in the year 2010.

Chapter Summary

A brief summary of this report is described below:

- Chapter two provides background information on the development of the AOC concept as well as an overview of the operational and system architecture of the AOC.
- Chapter three describes a recommended end state for the AOC of the future. Included is a discussion on how the end state statement is derived. Then, the recommended end state is compared and contrasted to today's AOC.
- Chapter four describes two change enablers—technology and doctrine—which may facilitate reengineering of the AOC. Based on these change enablers, two conceptual models are proposed for the AOC of the future. These models are then assessed using the criteria found in the recommended end state for the AOC of the future.
- Chapter five summarizes the results of this research project and the conclusions to be derived from those results. In addition, research initiatives revealed during this project are highlighted.

Notes

[1] Maj Tony Surber, HQ PACAF/XPXX, "RESEARCH TOPIC NAME: Air Operations Center of the Future: The AOC concept as currently employed requires further research into the issues of deployability, size, and asset usage.," on-line, Internet, 10 October 1997, available from http://www.au.af.mil/au/database/topics/ay1998/jcs-0101.htm.

[2] Executive Order 13011, "Federal Information Technology," 16 July 1996; on-line, Internet, 7 February 1998, available from http://irma.od.nih.gov/itmra/exo13011.htm.

[3] Air Force CIO, "Business Process Re-Engineering" on-line, Internet, 6 February 1998, available from http://www.cio.hq.af.mil/itbr.htm.

[4] "Business reengineering," "business process reengineering," and "process innovation" are a few of the popular terms used by practitioners to describe the technique of reinventing/revolutionizing the corporation.

[5] Michael Hammer and James Champy, *Reeingineering the Corporation A Manifesto for Business Revolution* (New York, N.Y.: HarperBusiness, 1993), 32.

[6] Ibid., 49.

[7] Thomas H. Davenport, *Process Innovation Reengineering Work through Information Technology* (Boston, Mass.: Harvard Business School Press, 1993), 1.

[8] Michael Hammer and James Champy, 36-46.

Chapter 2

The AOC of Today

> ***air operations cente****r—The principal air operations installation from which aircraft and air warning functions of combat air operations are directed, controlled, and executed. It is the senior agency of the Air Force Component Commander from which command and control of air operations are coordinated with other components and Services.*
>
> —Joint Pub 1-02

The American experience gained from four major wars and numerous contingencies led to the development of United States airpower command and control doctrine.[1] Although this experience was frequently punctuated by inter-Service rivalry over the appropriate operational-level command and control principles,[2] the airman came to realize that centralized control "was the best way to effectively employ airpower."[3] Today's AOC is the product of this evolved command and control doctrine. This chapter provides a brief description of the AOC and its role in airpower employment.

AOC Functions and Processes

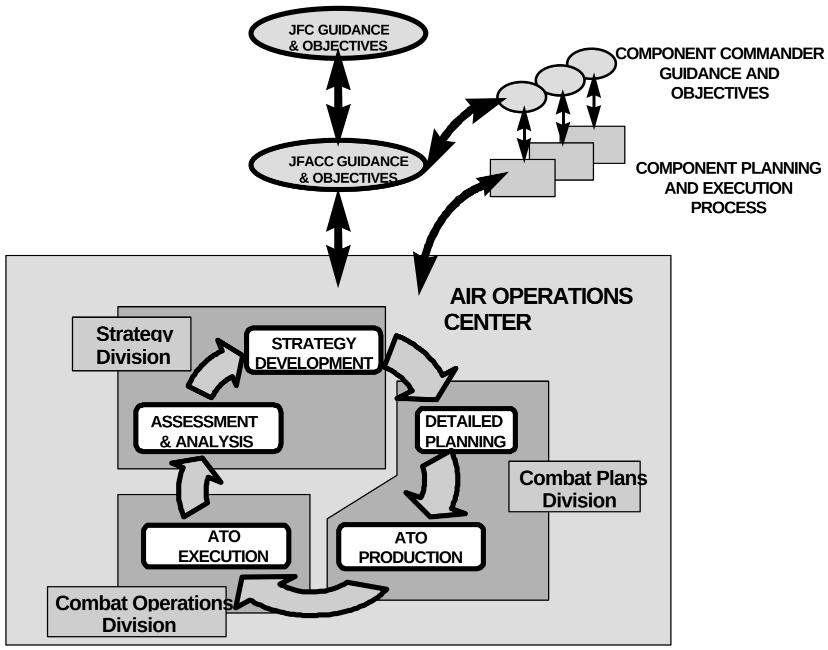
The AOC is a component of the Tactical Air Control System (TACS) and is responsible for the "centralized planning, direction, control, and coordination" of theater airpower employment.[4] According to Air Force doctrine, the specific functions of the AOC are as follows:[5]

- Develop air operations strategy and planning documents which integrate air, space, and information warfare to meet JFACC [joint forces air component commander] objectives and guidance.
- Task and execute day-to-day air operations; provide rapid reaction, positive control, and coordinated and deconflicted weapons employment, as well as integrate the total air effort.
- Receive, assemble, analyze, filter, and disseminate all-source intelligence and weather information to support air operations planning, execution, and assessment.
- Issue airspace control procedures and coordinate airspace control activities for the Airspace Control Authority (ACA) when the JFACC is designated the ACA.
- Provide overall direction of air defense, including TMD [theater missile defense], for the Area Air Defense Commander (AADC) when the JFACC is designated the AADC.
- Plan, task, and execute theater ISR [intelligence, surveillance and reconnaissance] mission.
- Conduct operational level assessment to determine mission and overall air operations effectiveness as required by the JFC [Joint Force Commander] to support the theater combat assessment effort.
- Produce and disseminate an ATO [Air Tasking Order] and changes.
- Provide for the integration and support of all air mobility missions.

In Joint doctrine, these functions are assigned as responsibilities to the JFACC.[6] Joint doctrine goes on to point out that the joint air operations center is the JFACC's operations center.[7] Both Joint doctrine[8] and Air Force doctrine[9] emphasize the need for dynamic organization based on the requirements of the mission. Normally, every AOC incorporates at least two functions—one responsible for combat planning and the other responsible for combat operations.[10] Figure 1 illustrates a notional example of the Air Force theater airpower planning and execution process accomplished within the AOC.

AOC Systems

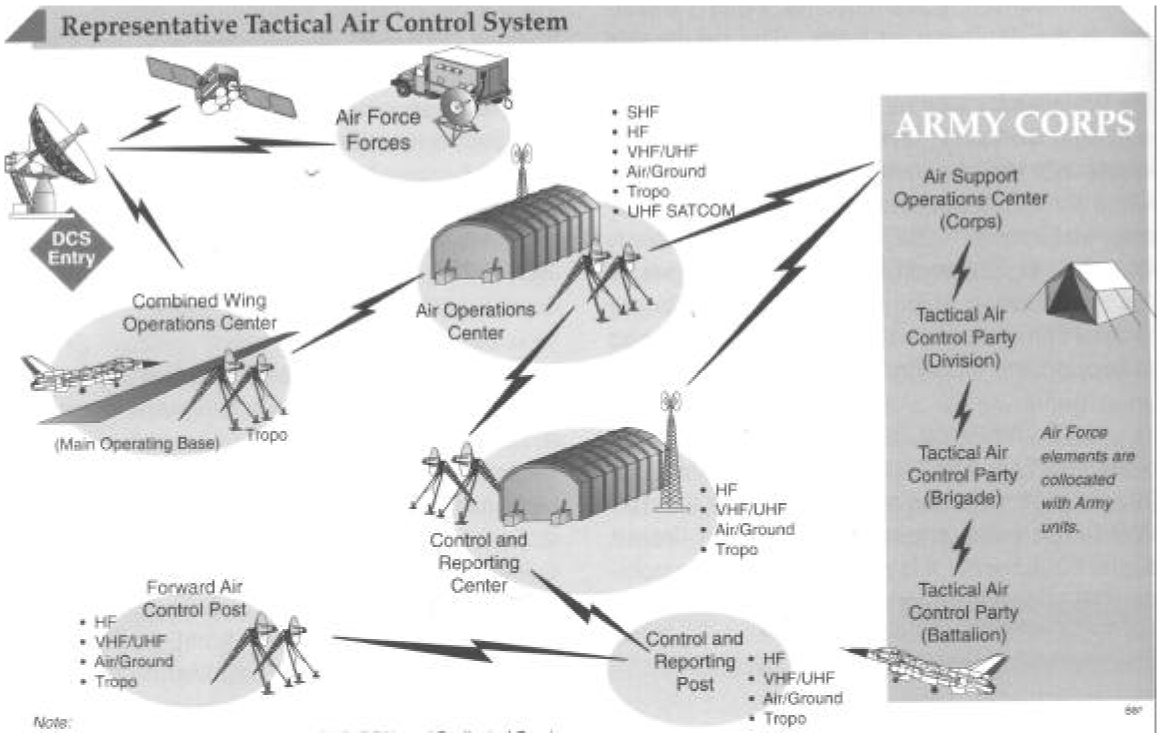
To accomplish the Herculean task of centralized control, the AOC is equipped with several data and communication systems. Again, a lack of AOC standardization prohibits a complete listing and discussion of specific AOC data systems. On the other hand, the Air and Space Command and Control Agency is tasked with developing a baseline AOC architecture.[11] Currently, they have identified 27 separate data systems as potential core AOC systems.[12] These systems support a wide range of airpower planning and execution activities.[13]



Source: *AFDD 2*

Figure 1. The Air and Space Planning and Execution Process

In addition to the numerous data systems comprising the AOC, the AOC is dependent upon a broad range of communication systems to interface with theater and continental United States (CONUS) organizations. Typically, the AOC is deployed to the area of operations and utilizes tactical circuits, military satellites, and commercial leased services (satellite, terrestrial, and cellular) for theater communications.[14] Radio and tactical data links support air-to-ground communications.[15] Predominantly, AOC's incorporate a "Reachback" capability to the CONUS through the use of satellite connectivity.[16] Due to the sensitivity of the intelligence and operations data, classified as well as unclassified connectivity is required.[17] All in all, a robust communications capability is required for the AOC to function effectively. A notional communications architecture depicting AOC theater interconnectivity is provided at Figure 2.



Source: C4I Handbook for Integrated Planning

Figure 2. Generic TACS Communication Architecture

The AOC—Still evolving

Due to the influence of both leaders and law,[18] US forces were more prepared than ever to fight as a joint team in the Persian Gulf War. At the heart of the air campaign was the AOC. From the AOC,[19] the Joint Forces Air Component Commander (JFACC) staff planned, coordinated, tasked, and controlled the launching of up to 3000 coalition sorties per day.[20] By any measure, this was an unparalleled feat in planning and coordination. In fact, the most "massive and intensive since World War II."[21] For some, the success of airpower in the Persian Gulf War is the validation of a mature tactical air control system.[22]

Although the Persian Gulf War air campaign was an overall success, significant room for improvement remains. As summarized by one analyst, "command and control in the Persian Gulf War was hampered by extensive uncertainty, imperfect information, equipment shortfalls, and the incompatibility of multigenerational equipment."[23] Others complained about the unwieldy 200 page air tasking order (ATO) which could take up to five hours to receive and print.[24] Their concerns did not fall on deaf ears.

Since the Persian Gulf War, many improvements were recommended and some already incorporated into the TACS.[25] Predominantly, these improvements focus on communications and system integration shortfalls. Consequently, the system architecture of the AOC continues to evolve.

Summary

As the airplane evolved as a weapon system, the command and control apparatus associated with it also evolved. Although parochial interest still reverberates, Desert Storm demonstrated the best coordination of joint air operations to date.[26] Today's AOC represents the third generation of this evolution and was at the heart of the successful Desert Storm air operations. Although today's AOC is doctrinally the same as the AOC of Desert Storm, the system architecture (i.e., data and communication systems) continues to evolve to exploit emerging technologies. But, will today's AOC meet the challenges of tomorrow?

Notes

[1] Air Force Doctrine Document (AFDD) 1, *Air Force Basic Doctrine,* September 1997, 23.

[2] A more detailed description is provided in Appendix A.

[3] AFDD 1, 23.

Notes

[4] AFDD 2 (DRAFT), *Global Engagement: Air and Space Power Organization and Employment*, Version 7, 33.

[5] Ibid., 34.

[6] Joint Pub 3-56.1, *Command and Control for Joint Air Operations*, 14 November 1994, II-2 thru II-3.

[7] This will be the only reference to the *Joint* Air Operations Center. For the purposes of this paper, the JOAC and the AOC are established by an Air Force JFACC and, therefore, are synonymous. There can be instances where the JOAC is established by a Navy JFACC or a Marine JFACC, but, as noted earlier, this paper will not discuss those exceptions.

[8] Joint Pub 3-56.1, II-7.

[9] AFDD 2 (DRAFT), 33.

[10] Joint Pub 3-56.1, II-7.

[11] Established in October 1997, ASC2A is chartered by the C2 General Officer Steering group to "pull command and control (C2) together across the Air Force." On-line, Internet, 10 Jan 98, available on http://wwwmil.acc.af.mil/asc2a/charter.htm.

[12] *Air Operations Center System List*, 11 July 1997; on-line, Internet, 10 March 1998, available on http://nova.agos.hurlburt.af.mil/AOC.

[13] See Appendix B for a listing of these systems.

[14] *Air Operations Center System List.*

[15] *C4I Handbook for Integrated Planning*, May 1996; 6-24.

[16] Ibid., 6-23.

[17] *Air Operations Center System List*

[18] Failed military operations like Desert One and URGENT FURY led to the enactment of the Goldwater-Nichols Department of Defense Reorganization Act of 1986 and a renewed emphasis on joint operations.

[19] In Desert Shield/Storm the AOC was called the Joint Air Operations Center (JAOC). Since General Horner was dual-hatted as the JFACC and the Air Force Component commander, the JAOC was essentially the Air Force's AOC organization augmented by other coalition and service liaisons.

[20] Thomas A. Keaney and Eliot A. Cohen, *Gulf War Air Power Survey Summary Report*, (Washington, D.C.: 1993), 23.

[21] James A. Winnefeld and Dana J. Johnson, *Joint Air Opeations Pursuit of Unity in Command and Control,1942-1991*, (Annapolis, Md.: Naval Institute Press, 1993), 123.

[22] Thomas A.Keaney and Eliot A. Cohen, 159.

[23] William Head and Earl H. Tilford, Jr (editors), *The Eagle in the Desert*, (Westport, Conn.: Praeger, 1996), 157-8.

[24] Thomas A.Keaney and Eliot A. Cohen, 149.

[25] Air Force Audit Agency, *Response to Command and Control System Problems Identified During the Persian Gulf Conflict*, Project 96054026, (Washington D.C: Air Force Audit Agency, 16 Dec 96).

[26] James A.Winnefeld and Dana J. Johnson, 109.

Chapter 3

AOC of the Future-Where are we going?

If you don't know where you are going, any road will take you there.

—Unknown

What challenges are in store for tomorrow's United States military? Nobody has a crystal ball. None the less, choices in force structure and capabilities must be made. To provide a common framework for these choices, a "joint" outlook is established in the strategic vision document *Joint Vision 2010* (JV 2010). This outlook guides Services in evolving their forces to meet the challenges of the future.[1] In the same manner, a vision for the AOC will provide a "conceptual roadmap" for determining needed capabilities.[2]

To develop a vision for the AOC, predictions by both Department of Defense officials and recognized futurists are reviewed to establish probable mission environment requirements for the AOC of the future. These requirements are used to develop a statement or "end state" which is a concise description of the AOC vision. Finally, this end state can be used to evaluate today's AOC to determine potential shortfalls.

Determining an End state for the AOC

A critical step in developing an AOC end state is determining its future mission requirements. This can be accomplished by determining the predicted strategic environment and understanding the capabilities of our potential adversaries.

Strategic Environment

Based on Strauss and Howe's generational model, the next millenium will not usher in a period of unprecedented peace. Their model predicts that the years 2004 through 2025 will be a "Crisis Era" for the United States. They contend that leaders will be preoccupied with "outer-world" peril and "wars are very likely."[3] In many ways, the Air Force envisions a similar future.

In *Global Engagement: A Vision for the 21st Century*, the security environment of "yesterday" is contrasted with "tomorrow." One of these differences is the unpredictability of the environment.[4] With unpredictable opponents and challenges, the United States can no longer design systems around a monolithic threat. Therefore, the AOC of the future must be flexible, i.e., able to provide airpower command and control for a broad range of missions. Another security environment difference highlighted is the emerging preponderance of military operations other than war (MOOTW).[5] Frequently, MOOTW operations are characterized by a need for rapid response and may be either brief or extended in time.[6] Whereas brief operations present no unusual technical or personnel challenges, extended operations raise concerns over logistical supportability and rotation of experienced personnel. In addition, MOOTW will usually involve integration of joint, as well as, multinational forces.[7] Hence, in order to support the increasing number of MOOTW, the AOC of the future must activate quickly and support extended and joint/combined air operations. Finally, *Global Engagement* points out that US forces will no longer enjoy a distinct technological advantage over its adversaries.[8] In the past, the air component commander leveraged communication, intelligence and surveillance capabilities to work inside his adversary's decision loop. With globalization of technology, this advantage will diminish. Therefore, hostile attacks and counterattacks may be accomplished more rapidly and punctuated by precise targeting. Consequently, the AOC of the future must help the air component commander stay inside the enemy's decision loop in a fluid operational environment.

Adversaries

In his book on future aerospace campaigns, Col Barnett postulates that the United States' most likely threat in the year 2005-2015 timeframe is from a "niche competitor."[9] (This postulate is endorsed in the *Report of the Quadrennial Defense Review*.)[10] Barnett defines a niche competitor as "…a state (or alliance) that combines limited numbers of emerging weapons with a robust inventory of current weapons, then develops an innovative concept of operations (CONOPS) to best employ this mix." He stipulates that the goal of the niche competitor will be to discourage or deter the influence of the United States in a region. Because it is militarily weaker, the niche competitor's innovative CONOPS will rely heavily on asymmetrical attacks against our operational centers of gravity to gain local advantage and/or induce unacceptable risks. Additionally, the niche competitor will most likely be located several thousand miles from the United States and able to coerce its neighbors; preventing or deterring forward basing of US forces.[11] Similarly, the 1997 Defense Review Panel predicted that future adversaries would learn from the Gulf War and seek to limit our forward presence and attack critical nodes like communications, transportation, and information systems.[12] Based on these predictions, the AOC of the future must adopt strategies to reduce, eliminate and/or protect its critical nodes and seek to minimize its presence (i.e., footprint) in the area of operations.

The End State

In summary, the AOC of the future must be flexible, quickly activated, support extended, integrated joint/combined operations, support fluid operational timing and tempo, limit critical node vulnerability and present a minimum footprint in forward areas of operation.

Today's AOC—Are we there yet?

Assuming the derived end state statement accurately depicts the *to-be* state for the AOC, then today's AOC falls well short of the goal. Predominantly, the shortfall is attributable to two areas—its deployment concept and its primary tasking mechanism, the air tasking order (ATO).

Deployment Concept. To deploy an AOC, both infrastructure and personnel must be deployed. In Desert Storm, transporting AOC infrastructure required about twenty C-141 sorties.[13] Upon arriving in theater, the infrastructure, which includes facilities and equipment, needs to be prepared prior to beginning operations. Then, the AOC needs to be staffed. Since there are no permanent-party AOC personnel, organizations are tasked to provide support. To support Desert Storm, the number of AOC staff and support personnel grew to almost 1500.[14] It is not too difficult to imagine the complex synchronization requirements and organizational difficulty of assembling both infrastructure and a team to fight the war.

Once deployed and operational in-theater, there are security and sustainment requirements. The AOC represents a high-value target. Just as the United States concentrated early precision bombing attacks on Iraqi leadership and command, control, and communications nodes,[15] capable niche enemies will target the brain of our TACS, the AOC. In addition to security, sustaining the AOC for extended deployments requires a logistics tail for equipment support and the care and feeding of personnel.

As is evident, the current deployment concept for the AOC does not satisfy the end state for the AOC of the future. Since the AOC is not fully activated until arrival and set up of infrastructure and key personnel, quick activation is improbable. Additionally, the theater proximity and collocated communication support of the AOC make this critical node vulnerable to identification and attack. Finally, the current deployment concept assumes all personnel and equipment required to support the air component commander in planning, control, and coordination of air and space operations are collocated in-theater.[16] Consequently, strategies to minimize the theater foot-print are not a focus of AOC deployment.

ATO. Throughout the Gulf War, the ATO remained a lightning rod for conflict. In the ensuing years, some of these conflicts were resolved with technological solutions. For example, the unwieldy ATO can now be transferred in seconds as opposed to hours by using direct broadcast system technology.[17] Likewise, the same technology coupled with installation of an Air Force contingency theater automated planning system terminal on Navy ships resolved a Navy-Air Force interoperability problem.[18] But, these were not the only deficiencies of the ATO process. Foremost among the criticisms is the 72-hour ATO cycle. Currently, ATO planning begins three days out. First, targets are assessed and recommended. Then, preliminary tasking is coordinated with flying and support units. On the third day the ATO is "flown." One study noted that "…the ATO sometimes went out late or incomplete (particularly early in the air campaign) and was still subject to change in any case."[19] One critic characterized the ATO process as "an attempt to run a minute-by-minute air war at a 72-hour pace."[20] In addition to concerns about timeliness of the ATO process, there is valid concern over whether the ATO process is consistent with Navy and Marine doctrine. In the Gulf War, both were reluctant to place assets under control of the ATO process. The Navy sought to retain sorties for fleet defense and the Marines "gamed" the system by overbooking sorties in the ATO.[21] On the other hand, our coalition partners integrated well with the ATO process.[22] Therefore, it is possible that some of the Navy and Marine criticism is borne of parochial concerns as opposed to the ATO process. Whether or not these differences are doctrinally or parochially based is open for argument. In either case, the AOC must implement processes which facilitate (as opposed to aggravate) integration of joint air forces to the greatest extent possible. In its current form, the ATO process falls short.

When evaluating the current ATO process against our end state for the AOC of the future, there are a few evident short-comings. Certainly, the 72-hour ATO cycle time opens an opportunity for an adversary to get inside the US airpower decision loop. In fact, a Navy intelligence cell surmised that Iraqi movement of combat planes every few days was based on Iraqi analysis of the three-day ATO cycle.[23] Additionally, the Iraqi CONOPS of "digging in" is not indicative of a fluid operational environment. Therefore, the success of air operations in the Gulf War may not be evidence of a responsive command and control system. Hence, the ability of the ATO process to support the air component commander in maintaining the initiative is, at best, suspect.

Summary

In developing an end state for the AOC, a tool for assessing the current AOC was developed. The assessment indicates that the AOC falls significantly short in meeting the desired end state. Through the use of business reengineering principles, it may be possible to determine a new model for the AOC which have the capabilities desired in the future.

Notes

[1] Joint Chiefs of Staff Office, *Joint Vision 2010*, Chairman's remarks.

[2] Edward Deevy, *Creating the Resilient Organization A RapidResponse Management Program* (Englewood Cliffs, N.J.: Prentice Hall, 1995), 94.

[3] John L. Petersen, *The Road to 2015 Profiles of the Future*, (Corte Madera, Calif.: Waite Group Press, 1994), 226-231.

[4] Air Force, *Global Engagement: A Vision for the 21st Century Air Force*, 1.

[5] Ibid.

[6] Joint Publication 3-07, *Joint Doctrine for Military Operations Other Than War*, 16 June 1995, IV-4 thru IV-7.

[7] Joint Publication 3-0, *Doctrine for Joint Operations*, 1 February 1995, V-1.

[8] Air Force, *Global Engagement: A Vision for the 21st Century Air Force*, 1.

[9] Jeffery R. Barnett, *Future War An Assessment of Aerospace Campaigns in 2010*. (Maxwell AFB, Ala.: Air University Press, 1996), xviii-xix.

[10] Department of Defense, *Report of the Quadrennial Defense Review*, May 1997, 5.

[11] Jeffery R. Barnett, 71-104.

[12] National Defense Panel, *Transforming Defense National Security in the 21st Century Report of the National Defense Panel*, December 1997, i.

[13] MGen John W. Hawley, "ASC2A Mission Brief," lecture, Air Command and Staff College, Maxwell AFB, Ala., 20 January 1998.

[14] MGen John W. Hawley.

[15] Thomas A. Keaney and Eliot A. Cohen, *Gulf Air Power Survey Summary Report*, (Washington, D.C.: 1993), 66-68.

[16] Air Force, *Presentation of USAF Forces Command and Organization of USAF Forces for Joint Operations*, Chap 3, p 3, on-line. Internet, 26 January 1998, available from http://nova.agos.hurlburt.af.mil/AOC.

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[19] Thomas A. Keaney and Eliot A. Cohen, 151.

[20] Thomas A. Keaney and Eliot A. Cohen, 150.

[21] Thomas A. Keaney and Eliot A. Cohen, 154.

[22] Thomas A. Keaney and Eliot A. Cohen, 158-9.

[23] Michael Gordon and Gen Bernard E. Trainor, *The General's War: The Inside Story of the Conflict in the Gulf*, (Boston, Mass.: Little, Brown and Company, 1995), 320.

Chapter 4

AOC end state—How do we get there?

After comparing the desired AOC end state to today's AOC, it is apparent that changes are needed. For the greatest improvement, the business reengineering model recommends reevaluation of assumptions in combination with leveraging technology.[1] This chapter demonstrates a business reengineering approach toward improving the AOC. In this approach, AOC assumptions are highlighted as potential change enablers. Then, enabling technologies are selected which can support redesign of AOC processes. Based on these change enablers, two models are proposed for the AOC of the future. The first model is a decentralized, theater-based AOC. The second model is a centralized CONUS-based AOC. To see how these models will meet the challenges of the 21st century, each are compared to the objectives presented in the AOC end state.

Reengineering Change Enablers

Faulty Assumptions

A core principle of business reengineering is that faulty processes are derived from faulty assumptions.[2] Consequently, the key to revolutionary improvement is to eliminate faulty assumptions. For the military, doctrine is at the core of its processes. As stated in Air Force doctrine, "basic doctrine provides broad and continuing guidance on how Air

Force forces are organized and employed." It goes on to say that basic doctrine is the "foundation" which sets the "tone and vision" for future doctrine development.[3] Furthermore, a perception of military doctrine is that it is "enduring."[4] Therefore, if a precept in military doctrine (or assumption/s that flow from the doctrine) is erroneous, then derived processes will most likely be defective. Consequently, the reengineering principle for the military may be to look for faulty doctrine and/or faulty assumptions flowing from the doctrine.

According to doctrine, the Air Force's first tenet of airpower is centralized control and decentralized execution.[5] The AOC is the embodiment of the "centralized control" aspect of this doctrine. Therefore, the change enabler for the AOC may be to question the doctrine of "centralized control" and derived assumptions. For example, is centralized control necessary or is centralized command sufficient? What constitutes centralized control—an ATO, commander's intent, Joint Air Operations Plan, etc.? Does the ATO have to be developed in a centrally located facility? Conceptually, is "centralized control" functional (JFACC and staff), physical (AOC facilities), or both? This is not an exhaustive list of potential "centralized control" questions, but it does indicate that biases or assumptions can lead to specific implementations of the AOC.

Information Technology

Often information technology (IT) is looked at as the silver bullet for improving an organization. Unfortunately, IT can actually hinder significant improvement when it automates archaic, inefficient methods of accomplishing a task.[6] Nevertheless, IT-based solutions, when applied appropriately, offer the best resource for bringing about "radical improvement."[7] To illustrate, Hammer and Champy cite several examples where IT enabled redrawing of organizational lines and work processes. Some of these examples are listed in Table 1.

Table 1. Enabling Information Technologies Change Paradigms[8]

Old paradigm: Information can appear in only one place at one time. ***Enabling technology:*** Shared Databases ***New paradigm:*** Information can appear simultaneously in as many places as it is needed
Old paradigm: Managers make all decisions ***Enabling technology:*** Decision support systems ***New paradigm:*** Decision making is part of everyone's job
Old paradigm: Plans get revised periodically ***Enabling technology:*** High performance computing ***New paradigm:*** Plans get revised instantaneously

AOC end state enabling technologies can be grouped under four technology types—decision support, expert, collaborative, and global network. These technologies are described below in more detail. An important clarification to note is that these do not represent disjoint groupings of technologies. They are interrelated and, at times, overlapping technologies. For example, it is difficult to discuss collaborative tools without understanding the interconnectivity provided by the global network. Likewise, decision support systems may incorporate expert system modules in their architecture. For clarity, these technologies are presented as distinct technologies. Additionally, this discussion is not presented to imply today's AOC does not leverage these technologies. In fact, an AOC core system, the contingency automated theater planning system, does incorporate these technologies in one form or another. As these technologies mature, even greater improvement can be realized.

Decision Support. As the name implies, decision support technologies help decision makers "generate, compare, and implement decision options."[9] In his article on next generation decision support systems, Andriole highlights that initially, decision support systems were designed to assist mid-level management decisions. He goes on to say that in the 21st century, decision support will be targeted to support decision making at all levels. He then points out that these systems will incorporate artificial intelligence and advanced user-interface methodologies (multimedia, virtual reality, etc.).[10] In the AOC, decision support systems can be used to accelerate decision making across all functional areas. For example, airpower strategy formulation, target nomination list production and ATO generation.

Expert. Expert systems[11] provide tools for problem diagnosis and/or remediation.[12] As alluded to earlier, there is a fine line between decision support and expert systems. The greatest distinction is that the former is process-based and the later results-based. Expert technologies frequently integrate extensive knowledge-based databases with sophisticated search tools (often incorporating artificial intelligence) to produce answer sets to queries. For the AOC, expert technologies can support several functions that include theater missile defense, center of gravity analysis, target-to-ordnance-to-weapon delivery selection, and battle damage assessment.

Collaborative. Collaborative technologies[13] are useful in integrating and coordinating information between functionally and geographically dispersed business units to complete a task. Collaborative systems incorporate three basic functions: information sharing, messaging, and document/task coordination.[14] In 1994, the Royal Australian Air Force tested a prototype collaborative ATO system. Their conclusion? collaborative technologies enabled "the right people to get the right information at the right time."[15] Likewise, an applicable usage of collaborative technology in the AOC includes the dynamic building and coordination of an ATO. During the building and coordination process, specialists in the Combat Plans Division, the Joint Intelligence Center, wing operations and squadron maintenance (or any other active participant) can add, delete, approve, and comment on the portions of the ATO which concern them. With collaborative technologies, these specialists can interact simultaneously, across geographic and organizational barriers.

Global Network. This last technology grouping encompasses the concept of the global real-time interconnectivity of information technology resources. In describing one of their network development projects, a Lucent Technologies official said their system "knits together voice, data, and video into a single multimedia network…[it] enables geographically dispersed team members to work together seamlessly, using all modes of communications as easily and spontaneously as the telephone."[16] These worldwide multimedia networks will be made possible by the proliferation of broadband commercial satellite networks in the first part of the 21st century. Already, five separate networks comprising over 400 satellites are planned.[17] Using satellite networks, information is relayed worldwide almost instantaneously.[18] For the military, worldwide interconnectivity of users, databases, and sensors in near real-time forms the basis of JV 2010's "dominant battlespace awareness."[19]

With worldwide instantaneous communication, different organization structures are now possible. As Hammer and Champy point out, many functions can now be highly centralized to take advantage of ease of control and/or economies of scale. On the other hand, other functions can be decentralized to gain advantages afforded by flexibility and responsiveness. They note that it doesn't necessarily have to be a choice of either centralization or decentralization. In Hewlett-Packard's material procurement process, some processes were centralized to gain volume discounts and others were decentralized to ensure remote operating units retained needed flexibility.[20] In the same manner, global network technology permits a rethinking of AOC concepts regarding centralization and decentralization.

How can these four technologies effect significant improvement in the AOC? They allow the redesign of organization boundaries and task processes. For example, the concept of a "virtual AOC" is now possible. Under a virtual AOC concept, geographically dispersed personnel assume AOC duties at their duty location. They accomplish their tasks using decision support, expert, and collaborative technologies interconnected via a global network. When the contingency is completed, AOC members return to their day-to-day tasks. Through leveraging IT, a virtual AOC is possible and collocation of all AOC members in the area of operations is no longer required.

AOC of the Future Concept Models

Through assessing potential change enablers, new models for the AOC can be developed. In this paper, two models, one at each end of the doctrinal spectrum, are proposed for evaluation. Consistent with business reengineering principles, each model challenges long held assumptions of AOC organization. Therefore, they may result in radical improvement of the AOC.

Decentralized Model

This first model leverages technology to redefine the doctrine of centralized control and decentralized execution. (A strong influence in deriving this model came from two articles published in Airpower Journal. One, written by LtCol Straight, describes the application of commander's intent for airpower.[21] The second, written by 1Lt Vincent, begins to outline an operational model to achieve "centralized command and decentralized control and execution."[22]) The goal of this model is to achieve radically greater combat efficiency through decentralization. As noted by one author, studies indicate that greater decentralization can create organizations, which are "more creative, adaptive, and open to innovation in response to rapidly changing conditions."[23] Hence, the decentralized model may leverage the operational arts facet of timing and tempo. In this model, the wing commander takes responsibility for planning and conducting operations at a tempo necessary to achieve the air component commander's objectives. Through placing day-to-day combat planning and execution in the hands of the combat units instead of the staff of the air component commander, the decision loop between planning and execution is minimized.

In the decentralized model, the air component commander and a small staff determine theater objectives and priorities in coordination with the Joint Forces Commander (JFC). When approved by the JFC, air objectives and priorities are assigned and disseminated to all combat units. As air operations unfold, the air component commander and staff monitor and direct the shaping of the theater air picture. Each combat unit receives the air component commander's updated guidance and adjusts day-to-day tempo and operations as appropriate for the emerging tactical picture. Concurrently, combat units dynamically coordinate theater-wide support and attack sorties (i.e., build the ATO) via collaborative technologies. With real-time dissemination of intelligence, surveillance, and reconnaissance (ISR) information, all share the same picture of the battlespace allowing combat units to take the initiative in concert with the developing tactical picture.

Analysis of Decentralized Model

Using the end state for the AOC of the future, the decentralized AOC model can be assessed for advantages and shortfalls.

Flexible. The decentralized model is flexible. This model implements a virtual AOC where the air component commander and geographically separated combat units coordinate air operations. There is no requirement for extraneous staff or equipment. Therefore, the size of the virtual AOC is driven by the requirements of the mission.

Quickly activated. From a technical viewpoint, the air component commander and staff could begin theater planning on laptop size computers in-garrison, enroute, or in-theater. Secure fax or secure modem can transfer planning information to participating combat units. On the other hand, combat units will not be able to begin operations until in-theater bed down (if deploying to the theater). Therefore, this requirement is only partially satisfied.

Support extended operations. With daily in-garrison access to the air operations planning/execution suite of equipment, hands-on command and control training would be incorporated into unit training. This facilitates personnel rotations and eases transition problems during extended operations. Since predominantly all of the AOC data systems are located in-theater with the air component commander and combat units, extended operations will require logistical support of equipment and supplies. Therefore, this model partially supports extended operations.

Integrated joint-combined operations. In some aspects, this model greatly facilitates joint operations. For the most part, this is the command and control model most preferred by Marine and Navy airpower operators. Historically, they prefer greater control of their air assets and this model gives them that control. On the other hand, if all services do not incorporate the same suite of tools, there can be serious interoperability problems. This is because the technology (decision support, expert, and collaborative) is pushed down to the combat unit level. Also, it is doubtful that our coalition/allied partners would invest in the same technology suite. Due to the sensitivity of various national asset collection capabilities, coalition/allied partners may not be given the same view of the battlespace that United States forces are provided. Therefore, the JFACC would need to use alternative methods for planning and coordinating airpower with coalition partners during combined operations. Because of this, the decentralized model does poorly in supporting combined operations.

Limit critical node vulnerability. One of the decentralized model's greatest strengths is its lack of vulnerability. This is achieved by dispersion of combat units and commander's intent resulting in no single critical node. Each combat unit operates either independently or as an integrated force depending upon the air component commander's plan. If communications are temporarily severed with the air component commander, combat units continue to conduct operations based on commander's intent. Therefore, an adversary can only achieve a temporary local effect by attacking a single combat unit.

Support fluid operational timing and tempo. The greatest advantage of the decentralized model is that it empowers the combat unit with freedom of action within the confines of commander's intent. This allows the combat unit to respond more rapidly to the emerging air picture. A case in point—one empirical study demonstrated that decentralized command and control simulation models allowed units to achieve "faster reaction time" and "higher kills."[24] Unfortunately, not all are convinced. Although not offering empirical evidence, one critic of decentralization suggests that the lack of centralized control of airpower will introduce unnecessary fog and friction.[25] Even if this hypothesis is accepted, it does not negate the assertion that decentralization supports increased timing and tempo. It only suggests that fog and friction may be increased. Thus, this model supports fluid operational timing and tempo.

Minimum footprint in forward areas of operation. In this decentralized model, all personnel and equipment are distributed throughout the combat units and are located within the theater of operations. Additionally, it is assumed that the air component commander and staff are located within the theater. Therefore, this decentralized model does not support the objective of a minimum footprint in the forward area of operations.

Centralized Model

The second model rethinks the AOC by leveraging global network technology to retain AOC functions at non-deployable fixed sites. In this model, each combatant commander establishes a single permanent AOC for conducting all air operations within its geographic area of responsibility. The AOC is sufficiently equipped to support simultaneous multiple contingencies. During peacetime, a core staff supports training and exercises. As operations warrant, additional personnel augment the AOC. If needed, the air component commander and a small staff deploy to the theater with the joint forces commander to coordinate air apportionment guidance and theater objectives.

Col Barnett advocates this model in his book *Future War*. It is also similar to the Tanker Airlift Control Center (TACC) in operation today. Located at Scott Air Force Base, IL, the TACC plans, schedules, tasks, and executes over 250 airlift and tanker worldwide missions each day.[26] In the same way, the single AOC could accomplish centralized command and control of all tactical airpower in the geographic area of responsibility. Through leveraging the near real-time capabilities of the global network, the AOC staff has an instantaneous view of the battlespace. Collaborative tools assist the staff in planning, coordinating and tasking day-to-day air operations with combat units. Decision support and expert tools assist everyone in assessing impacts of operations, charting strategy, additional operations (branches and sequels) and/or restrikes.

Analysis of Centralized Model

Using the end state for the AOC of the future, the centralized AOC model can be assessed for advantages and shortfalls.

Flexible. The centralized model is flexible. The facility is appropriately sized and equipped to meet a broad range of contingencies. Likewise, the staff grows with the size of the operations. With almost all planning and coordinating accomplished through the centralized AOC, tactical combat units initially require only rudimentary communications connectivity for receiving the ATO. As strategic airlift becomes less stressed, more sophisticated collaborative systems can be installed at deployed combat unit locations.

Quickly Activated. Since equipment and core staff is in-place, planning for any contingency can begin as soon as warranted. With a fixed site, communications infrastructure is already in place. With the projected commercial satellite capability, full satellite communications, with end-to-end encryption, can be provided within minutes of arrival of combat units in theater.[27] Therefore, the AOC can be quickly activated.

Support extended operations. With a standing core staff, the AOC is always manned with experienced personnel. When the staff needs augmenting, inefficiency may be introduced due to integration and rotation of lesser trained augmentees. On the other hand, the fixed, non-deployed location ensures theater logistic systems are not tasked for support. All told, the centralized AOC supports extended operations.

Integrated joint-combined operations. From an interoperability perspective, the centralized model simplifies interoperability requirements. With centralized planning, coordination, and control, the required systems are predominantly maintained within the fixed AOC. To assure interoperability, the ATO can be sent via various communications media using an agreed to or commercial standard.

From an integrated joint and coalition/allied perspective, the prognosis is a little murkier. With greater centralization, inter-service battles over control of airpower assets may intensify. This is due to the reluctance of land and naval commanders to turn over day-to-day control of needed combat support airpower to an organization so disembodied from combat operations. On the other hand, integration with coalition/allied partners is simplified. They will not need special, interoperable equipment to receive the ATO. Also, they can receive a compartmented view of the battlespace within the AOC. Finally, past experience indicates coalition/allied partners accept, within parameters, United States-led centralized command and control structures.[28] Given an interoperable architecture and acceptance of United States' command and control, there are no perceived impediments to combined operations for the centralized model.

Limit critical node vulnerability. With fixed operations outside of the contingency's area of interest, the risk of direct attack on the AOC is greatly reduced. But, it could be that the niche adversary's innovative CONOPS includes a way to attack or severely degrade this critical node. For example, the niche adversary may be able to attack facilities via subversion or terrorism. Van Creveld suggests that this type of attack may become the norm.[29] Another form of attack may include hacking into the commercial satellite service and temporarily or permanently disrupting service and/or introducing misinformation. Hence, the highly centralized model is susceptible to the lethal "decapitation attack."[30] Consequently, risk mitigation strategies like redundant communication paths and alternate-AOC locations are critical for the centralized model.

Support fluid operational timing and tempo. As already discussed, airpower doctrine maintains that centralized control is essential for "controlling and coordinating the efforts of all available forces."[31] Col Barnett suggests that rapidly changing theater objectives and parallel warfare execution demand highly centralized coordination of geographically dispersed airpower assets.[32] If true, the centralized model may be the most responsive to theater-wide operations tempo. On the other hand, LtCol Roman's paper on airpower command and control offers another viewpoint. In it, he draws from both the American military experience and organization theory to conclude that highly centralized control will not meet the demands of the operating tempo required in future warfare.[33] Therefore, the centralized model may support theater operational timing and tempo, but hinder optimum tactical operational timing and tempo.

Minimum footprint in forward areas of operation. An underlying assumption of this model is that the geographic combatant commander will site the fixed AOC in an optimal peacetime location. This site would have ready access to an economical, efficient, robust communications and logistics infrastructure. Depending on cost/benefit analysis, the optimal site may be in the CONUS. If not, the fixed AOC should not be sited in a hostile theater of operations where it is vulnerable to attack or encumbers the theater logistical system. If overseas based and the situation warrants, AOC could relocate to an alternate location outside of the theater of operations or in the CONUS. Therefore, the centralized model can fully support airpower operations without a forward presence.

Summary

Through challenging long held assumptions and leveraging technology, two distinct conceptual models for the AOC were defined. Although neither appear to optimally satisfy the desired end state, both exhibit significant advantages and disadvantages over today's AOC. It could be that the best model for the AOC of the future lies somewhere in-between these proposed models.

Notes

[1] Michael Hammer and James Champy, *Reeingineering the Corporation A Manifesto for Business Revolution,* (New York, N.Y.: HarperBusiness, 1993), 85-90.

[2] Michael Hammer and Steven A. Stanton, *The Reengineering Revolution A Handbook*, (New York, N.Y.: HarperBusiness, 1995), 103-116.

[3] AFDD 1, Air Force Basic Doctrine, March 1992, 2.

[4] Joint Publication 1, *Joint Warfare of the Armed Forces of the United State*s, 10 Jan 1995, I-3.

[5] AFDD 1, 23.

[6] Michael Hammer and James Champy, 83-101.

[7] Thomas H. Davenport, *Process Innovation Reengineering Work through Information Technology,* (Boston, Mass.: Harvard Business School Press, 1993),17.

[8] Michael Hammer and James Champy, 92-99.

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[9] Stephen J. Andriole, "Advanced Information Technology for Next Generation Decision Support" in *Advance Technology for Command and Control Systems Engineering* (Fairfax, Va.: AFCEA International Press, 1990), 367.

[10] ibid, 368-384.

[11] Sometimes referred to as "intelligent expert systems" or "intelligent systems."

[12] John W. Sutherland, "Moving from Expert Systems to Intelligent Systems Technology in Command/Control Contexts" *in Advance Technology for Command and Control Systems Engineering* (Fairfax, Va.: AFCEA International Press, 1990), 234-235.

[13] Collaborative technologies is synonymous with those systems marketed as groupware. I prefer the term collaborative because it is more descriptive than the techno-speak term "groupware."

[14] Cheryl Currid and Company, *Computing Strategies for Reenginneering your Organizaiton,* (Rocklin, Calif.: Prima Publishing, 1994), 208.

[15] John O'Neill, "The Role of Groupware in C3I Systems" in *Proceedings of the First International Symposium on Command and Control Research and Technology* (Washington, D.C.: National Defense University, 1995), 149.

[16] Curtis J. Crawford speech entitled "Major Trend in Global Communications the Multimedia Revolution" in *Vital Speeches of the Day*.

[17] John Montgomery "Fiber in the Sky," *Byte* 22, no. 11 (November 1997): 61.

[18] Sam Masud, "TCP overhaul needed for satellites" *Computer Reseller News* 702 (23 September 1996): 12.

[19] Joint Chiefs of Staff Office, *Joint Vision 2010*, 8.

[20] Michael Hammer and James Champy, 93-95.

[21] LtCol Michael Straight, "Commander's Intent An Aerospace Tool for Command and Control?," *Airpower Journal* 10, no. 1, (Spring 1996): 34-48.

[22] 1Lt Gary A. Vincent "A New Approach to Command and Control the Cybernetic Design" in *Airpower Journal* 7, no. 2, (Summer 1993): 15-25.

[23] William Head and Earl H. Tilford, Jr., *The Eagle in the Desert Looking Back on U.S. Involvement in the Persian Gulf War,* (Westport, Conn.:Praeger, 1996), 168.

[24] Tommy Lee and Sumit Ghosh, "A Novel Approach to Asynchronous, Decentralized Decision-Making in Military Command and Control" in *Proceedings of the First International Symposium on Command and Control Research and Technology* (Washington, DC: National Defense University, 1995), 432.

[25] Jeffery R. Barnett, *Future War An Assessment of Aerospace Campaigns in 2010*, (Maxwell AFB, Ala.: Air University Press, January 1996), xxiii.

[26] "The Tanker Airlift Control Center Directorate Overview" on-line Internet http://tacc.safb.af.mil/taccstaf.htm

[27] OASD, *C4I Handbook for Integrated Planning* (Washington, DC: May 1996), 6-11.

[28] Thomas A. Keany and Eliot A. Cohen, *Gulf War Airpower Survey Summary Repor*, (Washington, D.C., 1993), 158.

[29] Martin Van Creveld, *The Transformation of War,* (New York, N.Y.: The Free Press, 1991), 223.

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[30] Maj Scott Norwood, *Thunderbolts and Eggshells Composite Air Operations during Desert Storm and Implications for USAF Doctrine and Force Structure* (Maxwell AFB, Ala.: Air University Press, September 1994), 30.

[31] Joint Publication 3-56.1, *Command and Control of Joint Air Operations*, 14 Nov 1994, I-2.

[32] Jeffery R. Barnett, xxii-xxiv

[33] Lt Col Gregory A. Roman, *The Command and Control Dilemma: When Technology and Organization Orientation Collide*, (Maxwell AFB, Ala.: Air War College, Air University Press, 1997).

Chapter 5

Summary and Conclusions

Summary of Findings

As opposed to seeking incremental process improvement, this research project applied reengineering principles to redesign the AOC process. At the heart of this reengineering principle is the willingness to discard previous assumptions and start with a clean slate. By developing an end state for the AOC process, core mission environment requirements in which the AOC will operate surfaced. This end state formed the criteria with which to evaluate the current AOC model and proposed conceptual models. Table 2, summarizes the results of these assessments.

Table 2. Summary of AOC end state assessment

End State Criterion	AOC	Decentralized AOC	Centralized AOC
Flexible	👍	👍	👍
Quickly Activated	👎	👍	👍
Support short-extended operations	👎	👍(Partial)	👍
Integrated joint-combined operations	👎(Joint) 👍(Combined)	👍(Joint) 👎(Combined)	👎(Joint) 👍(Combined)
Limit critical node vulnerability	👎	👍	👎
Support fluid operational timing and tempo	👎	👍(Combat Unit) 👍(JFACC)	👎(Combat Unit) 👍(JFACC)
Minimum footprint in forward areas of operation	👎	👎	👍

Conclusions

A Conceptual Model for the AOC of the Future?

Although these results are encouraging, they do not definitively point to "the" model for the AOC of the future. First, neither model is completely congruent with the desired end state. Therefore, this may suggest either the end state is not feasible or it may suggest that a hybrid combining various attributes of the two models is a better AOC model. Second, there is no authoritative, independent validation of the end state proposed in this research project. Thus, the end state criteria may not fully reflect mission environment requirements for the AOC of the future. To validate the end state criteria and develop alternate models, the Air and Space Command and Control Agency could form an AOC reengineering team. This team of AOC process experts would bring invaluable experience not captured in the material available for this research effort. Consequently, the synergistic efforts of the reengineering team may define the optimum

AOC end state and conceptual model. Finally, the research approach does not include cost/benefit analysis as a part of assessing the conceptual models. With certainty, migration from today's AOC to the AOC of the future will require an investment. Given current budget trends, projected costs of this migratory path is a key consideration and/or constraint. Nonetheless, conducting cost/benefit analysis was beyond the scope of this research project.

Recommendations for Additional Research

In pursuing this research project, there were several avenues of research that could not be pursued within the project's scope. Of these, two are worthy of specifically noting. One is directly related to determining the AOC of the future. The other relates to the selected reengineering approach.

As indicated in some of the discussion within this paper, there are considerable differences of opinion regarding the appropriate amount of centralized control of airpower. This discussion needs to move beyond opinion. To do this, researchers should design investigations to collect empirical evidence on the appropriate degree of centralized control. Important to this discussion is Hammer and Champy's thesis that it is not a case of "either/or" with regard to centralization and decentralization. Technology now supports concurrent decentralized and centralized organizational processes.[1] In coordination with the Air Force Command and Control Battle Lab, airpower command and control simulation models and exercises that incorporate various degrees of centralization could be investigated. Then, decisions on airpower command and control can be fact-based as opposed to opinion-based.

Another area of research would concentrate on strategies for assessing conceptual process models. To reduce as much complexity as possible, the approach chosen for this research project used a simple assessment model. Although more complex, would using weighted values of criteria be more appropriate? When developing and evaluating conceptual process models, how much emphasis should there be on developing objective versus subjective criteria? Should cost/benefit analysis be included in the initial model assessment? These questions are just a sampling to indicate the need for further research in assessing conceptual models.

Research Conclusions

Based on the results of the assessment, the reengineering approach presented in this research indicates that radical improvement of the AOC is possible. Of the seven end state criteria, the AOC of today fully or partially satisfies two. Conversely, each of the proposed models fully or partially satisfies six of the seven required end state criteria. This represents a threefold improvement in meeting AOC of the future end state criteria. Consequently, when satisfaction of end state criteria is the measure of an acceptable conceptual model, both the proposed decentralized and the centralized models posit significant improvement over today's AOC model.

In addition to the AOC specific findings, this research project demonstrates applicability of reengineering principles to an Air Force problem. In developing an end state (or vision) for the AOC, a tool for assessing conceptual models emerged. Similarly, other Air Force reengineering teams can develop and use a process end state as the basis for developing and assessing new process models. Another reengineering approach used in this research was to look at doctrine and its impact on the process. As suggested by this research, a willingness to change doctrine or assumptions flowing from doctrine may lead to the output of reengineering—dramatic improvement. It is reengineering, not incremental process improvement, that charts the path to the future. As aptly stated in a recent radio commercial, “If you keep doing things like you’ve always done them, what you’ll get is what you’ve already got.”[2]

Notes

[1] Michael Hammer and James Champy, *Reeingineering the Corporation A Manifesto for Business Revolution*, (New York, N.Y.: HarperBusiness, 1993), 93-95.

[2] Radio Commercial, 1994, cited in “Philosophy Quotes,” on-line, Internet, 25 February 1998, available from http://www.bfm.nl/quotes/quote.html.

Appendix A

Brief History of the Evolution of Airpower Command and Control

World War II

As a weapon system, the airplane came into it's own during WWII. During this time period, airpower doctrine, as well as, technology and tactics were in their infancy. This was most evident in the inconsistent organization of command and control relationships within different theaters of the war. It was in the European theater, though, where the roots of the AOC began to take hold.

Within the European theater, the preponderance of airpower belonged to only one service—the US Army Air Corps. Therefore, the chore of establishing command and control relationships was somewhat simplified. With the appointment of the Allied Expeditionary Air Forces as the air component command for coordinating Allied tactical bombers and fighters, the doctrine of unified command emerged.[1] For the first time, Army Field Service Regulation 100-20 officially endorsed this command arrangement in its 1943 publication as follows:

> The inherent flexibility of air power is its greatest asset. This flexibility makes it possible to employ the whole weight of the available air power against selected areas in turn … control of available air power must be centralized and command must be exercised through the air forces commander if this inherent flexibility and ability to deliver a decisive blow are to be fully exploited.[2]

By the time of the Normandy invasion, a rudimentary, but effective, tactical air control system emerged. In his book on command and control, Allard quotes German communications which attested to the tremendous effectiveness of this system[3]. In summary, our World War II experience saw both the concept of centralized command and control and the beginning of a tactical air control system appear.

Korean War

In the intervening years prior to the Korean War, the passage of the National Security Act of 1947 established the Air Force as a separate service and set up a unified command structure among the services.[4] Unfortunately, this did not stop the inter-Service rivalry over control of airpower which was seen earlier in World War II's Pacific theater. To rectify this, Gen MacCarthur, Commander in chief Far East, stipulated that Lt Gen Stratemeyer, Commander of Far East Air forces, had *coordination control* over all air missions (Air Force, Marine, and Navy) conducted in Korea.[5] In addition, the first joint operations center (JOC) was established to coordinate all air and ground operations in the theater. Specifically, the JOC "was to provide the tools for directing a tactical air campaign and to match requirements for air support operations with air resources available."[6] As with World War II, two major AOC concepts emerge from the Korean War—the Air Force as coordinator of the theater air campaign and a center responsible for centralized control of airpower.

Vietnam

Of the many lessons to be learned from the Korean War experience, inter-Service command and control of airpower was neglected. As with America's previous wars, the

Vietnam War airpower experience was marked by intense rivalry among the Services. In fact Winnefeld and Johnson concluded that "…command and control of tactical air operations were unsatisfactory and would have led to disaster if U.S. Forces had faced a capable air opponent."[7] It was only after the debacle at Khe Sanh did the Deputy Secretary of Defense intervene and appoint a theater single manager for air—the Air Deputy of Military Assistance Command, Vietnam. One bright spot in an otherwise dim prognosis was the codification and formalization of the tactical air control system (TACS). The TACS became the foundation upon which the Army and Air Force would coordinate airpower for the Air-Land battle.

Notes

[1], Thomas A Cardwell, III, *Command Structure for Theater Warfare The Quest for Unity of Command* (Montgomery, Ala.: Air University Press, 1984), 9.

[2] Quoted in Kenneth Allard, *Command, Control, and the Common Defense* (Washington, D.C.: National Defense University, 1996), 108.

[3] Kenneth Allard, *Command, Control, and the Common Defense (W*ashington, D.C.: National Defense University, 1996), 109.

[4] Cardwell, 12.

[5] James A. Winnefeld and Dana J. Johnson, *Joint Air Operations Pursuit of Unity in Command and Control 1942-1991* (Anapolis, Md.: Naval Institute Press, 1993), 42.

[6] James A. Winnefeld and Dana J. Johnson, 43.

[7] James A. Winnefeld and Dana J. Johnson, 63.

Appendix B

AOC System List

The following information system list was downloaded from the Air Ground Operations School Internet website available at http://nova.agos.hurlburt.af.mil/AOC.

Table 3. Systems (Current as of 11 Jul 97)

SYSTEMS	DESCRIPTION	COMMENTS
BINO-CULAR	NSA correlates into TIBS/TDDS message at hub and transmits correlated data	accesses NSA sensor data. Mapping tool needs to be compatible with CTAPS/TBMCS
C2IPS - AMC C2 Information Processing System	Plans theater airlift missions. Monitors all air mobility arrivals, departures, diverts & overflights in theater	Requires full interface between CTAPS/C2IPS databases and applications using the EOI.
CIS 1.2	Combat Intelligence System. Includes AA, MA, DM, 5D, IMOM, RAAP	Input: TIBS, TRAP, TADIL A, DIA Reference Database, Imagery, Battle Damage Assessments (BDA), Maps Output: Theater Databases; Facility, Equipment, etc. All Order of Battles.
1. 5D CIS	Imagery Server	DIA Imagery
2. IMOM CIS	Improved Many On Many	Input: Threat Database, Electronic Order of Battle and Air Order of Battle Output: Visual Analysis
3. RAAP CIS	Rapid Application Of Air Power Provides targeting tool in TBCMS to help develop weaponeered Target Nomination List	Input: Facility Database Output: Target Nomination List (TNL)

Table 3(cont.)

CTAPS	Contingency Theater Automated Planning System	(12 AF expanding)
1. ADS CTAPS	Airspace Deconfliction System	Inputs: Manual Updates Output: Air Space Control Order (ACO)
2. APPLIX CTAPS	Desktop Software, Word processing, spread sheet, and slides.	
3. APS CTAPS	Advance Planning System	Inputs: TNL, ACO, Order of Battles, Weaponeering Options Output: Air Tasking Order (ATO), Planning Database
4. CAFMS CTAPS	Computer Assisted Force Management System Provides graphic Gantt chart display of ATO to monitor execution	Input: ATO Planning Database Output: Mission Status
5. CAFWSP	Combat Air Forces Weather System	
6. IWA CTAPS	Interactive Weather Analysis	Input: AWN, Manual Updates Output: Visual Analysis, Weather Status
Copy Systems	Copy machines	Plain paper
E-STT	Enhanced Small Tactical Terminal Provides reception of weather satellite imagery.	
EOI	E O Interface	RFI
ESK	Electronic SWO kit Provides acquisition of weather graphics data.	
FAX System	Secure/Unsecure FAX system	Plain paper
GALE	Ground Area Limitation Environment	
GCCS COP V. 2.2	Global Command and Control System Common Operational Picture (Capt Ryan - AMC expanding definitions)	Inputs: TIBS, TRAP, TADIL A, TADIL B, TADIL J, OTH GOLD, ATO, ACO, Manual Status Updates Outputs:
GDSS	Global decision Support System (AMC C2)	AME Team Brings to AOC
GPS PLGER	operational model to exploit GPS accuracies (OMEGA)	Space Team Brings with them

Table 3 (cont.)

JDISS	Joint Deployable Intelligence Support System a transportable workstation and comm suite that electronically extends a joint intell center to a JTF or other tactical user • 5D - Demand Driven Digital Data Dissemination • Adversary - analysis tool(JDISS-based database) • ALE - Aires Life Extension • Alert - part of comm desktop application • AMHS - Automated Message Handling System • Anchory - access to NSA SIGINT database • Carillon - access to NSA WRANGLER database • Chatter - part of comm desktop application • CIRC II - Technical Equipment Info Database • Coliseum - Production requirements tracking sys • CRMA (Collection Rquts Mgt Application • Crystal Ball - Non-real time signals ID package • DAWS - Defense Automated Warning System • ELT - Electronic Light Table • FTP - File Transfer Protocol • GALELITE - mapping application • Intelink - Netscape window for access to various databases and file across the network • JEAP Sunshine - mapping application • JISST - Joint Interoperable SIGINT Spt Tools • Office Tools - access to word processing, e-mail, database, spreadsheet & graphics applications	provides a core intelligence function, at the SCI level, between JTF components • Imagery database • allows historical imagery queries • generate/send short priority messages • generate/send/receive text messages • Secure comm via keyboard & voice • formerly RFI tracking system forwards intel rquts to JICs, JAC • IMINT, SIGINT, & MASINT collection mission tracks (past, present & future) • generate/send/receive text messages • JDISS imagery manipulation tool • File transfer between workstations • Replaces JEAP Sunshine for some aps • SCI Internet • Displays data of WRANGLER database • NRTD, NRTI, F3S, etc. • For C2 critical node analysis/display • Comm pathway/connectivity analysis • historical queries of text messages • Transfer files between workstations

Table 3 (cont.)

JDISS (cont.)	• Oilstock - mapping application • PING - part of comm desktop application • SAFE - access to DIA national database • Send File - part of comm desktop application • Sensor harvest – Interactive Analysis Tool of JDISS based Links and Nodes • Tinman - JDISS based database analysis tool WRANGLER - access to NSA ELINT database	provides interactive links & nodes C2W
JPT (V?)	JFACC Planning Tool Provides objective-based target list development tool for force application targets 1. Strategy to Task Planner 2. Offensive Planner	Input: NCA, CINC, and Theater Commander directions, friendly and enemy target lists Output to Offensive: Facility Target List Output to Defensive: Defended Asset List & priorities, defensive constraints, rules of engagement constraints Output to Logistics: TBD Output to ISR: TBD
MSTS	Multi-Source Tactical System	Space Team Brings
PC JMEM	PC Joint Munitions Effectiveness Manual	Weaponeering
QRCT	Quick Reaction Communications Terminal Reception of weather data over HF radio.	
RMS	Requirements Management System	Displays validated imagery Rquts.
SENIOR TROUP	transmits/receives/sanitizes/disseminates intelligence Information, SENSOR PACER messages	TADIL-capable, secure/nonsecure voice capable w/AWACS/RIVET JOINT/SENIOR SCOUT/EP-3/TADIL users
Shredder	approved shredder	
SOCRATES	Communication to SOF	SOF Team Brings
TEP VAN	receives/processes/displays/analyses tactical & national ELINT, receives DARPASAT related data	
TFS	Tactical Weather Forecasting System	
TRT	Tactical Radio Terminal Reception of HF radio broadcast of weather data.	
TSOC	Theater Space Operations Cell	Space Team Brings with them

Table 3 (cont.)

TWOS	Tactical Weather Observing System	
WCCS	Wing Command and Control System WCCS is the unit level component of TBMS provides wing unit resource data.	Input: ATO, ACO, AWN, Manual Status Inputs, Aircraft Status (CAMS), Crew Status and qualifications (AFORMS) Output: Aircraft and Air Base Scheduling, ABSTATs, TACREPs, Various Wing Tailored report.

Table 4. Communications (Current as of 11 Jul 97)

SYSTEMS	DESCRIPTION	COMMENTS
ADSI	Air Defense System Integrator. Communications processor used to receive TADIL A, B, J, TIBS, and TRAP. Converts datalinks to TCP/IP packet format.	TADIL A,B,J, and OTH-GOLD TIBS and TRAP
AFSATCOM	Air Force Satellite Comm System	
Data/Voice Encryption/Decryption Devices	KY-68, KG-84s, KG-194s, STU-IIIs, KOI-18s,KIV-7HS,KY-99A,NES, KYK-13 etc..	Voice and Data, and Video
DISN LES	DISN Leading Edge Services	
GBS	Global Broadcast Service Video requires dish antenna, setup box, and TV. Data requires setup above PLUS rate buffer module, KG-194, Cisco router, 10BaseT connector, and Sun Sparc Workstation. CNN required	Video, data, and voice
Hammer Rick	Tactical satellite capability (TACSAT)	
INMARSAT B (64Kbps) (Data capable)	International Maritime Satellite System Provides reception of weather data & initial imagery capability	
JWICS	Joint Worldwide Intelligence Comm System Provides T-1 secure comm for multi-media SCI connectivity	Handles data, electronic publishing, video teleconferencing, etc. Replaces DSNET 3

Table 4(cont.)

MILSTAR Terminal	Provides robust satellite comm	
MLS	Multi-Level Security	ISSE Guard candidate
NIPRNET	Unclassified local base network connectivity for personal computers	
POTS	Public Owned Telephone Systems. Including cellular & pager services	Voice and data
RADIOS	UHF, VHF, HF, LMR, & Have Quick II/DAMA	
SIPRNET	Secure TCP/IP Network to provide connectivity to Secret WANs	
STAMPS	Standard Tactical Automated Message Processing System, AUTODIN message processing systems for CIS, WCCS, and CTAPS	USMTF messages
STOMPS	Stand-alone Message Processing System	Provides the interface to receive AUTODIN traffic.
TASDAC	TASDAC is a data concentration and routing system designed to accept a number of different protocols.	Interfaces with AFMSS, CTAPS, WCCS, CIS, and any other data system meeting the TBM unit level open system architecture standard.
TDC	Theater Deployable Communications Provides voice, data, message, video and imagery services using commercial standard equipment. Consists of satellite terminal and flexible comm backbone for high speed network access. IDNX	
TRE	Transmission Receive Equipment. Antenna and communications equipment for receiving live TIBS and TRAP information	TIBS, TRAP, TDBS
TRI-TAC	Tri-Service Communications – Consists of common user voice, data and message equipment	

Table 5. INTERFACE LIST (Current as of 11 Jul 97)

SYSTEMS	DESCRIPTION	COMMENTS
AFATDS	Advanced Field Artillery Tactical Data System	Input: ATO, TNL
AFMSS V. 2.0	Air Force Mission Support System – Automated system for mission support including flight planning, threat analysis, weapon/airdrop planning, and post mission analysis.	Input: Maps, Order of Battle, ACO, ATO Output: Visual Route Analysis, Mission Documents, Data Transfer Cartridge (DTC)
AMES	ATO Mission Entry System Enables ARMY to get missions into CTAPS	Army inputs flying schedule into AMES using (MS Access) database format. ARRC consolidates uploads into CTAPS vis CAFMS MDU
ASAS (US Army)	All Source Analysis System Warrior Displays Red Force GOB	Integrates, correlates & analyzes US Army SIGINT, COMINT, ELINT
FLTSATCOM	Fleet SATCOM (DAMA)	Comm to Carrier Battle Group
JMCIS	Joint Maritime Command Information System (Navy C2 System)	
MCE AATO	Modular Control Equipment Automated Air Tasking Order (Receive)	Input: ATO
TACCIMS	Theater Army C2 Info Management Sys	Army Team brings
WCCS	Wing Command and Control System	provides aircraft & air base schedules

Glossary

AADC	Area Air Defense Commander
ACA	Airspace Control Authority
AF	Air Force
AFB	Air Force Base
AOC	Air Operations Center
ATO	Air Tasking Order
CONOPS	Concept of Operations
CONUS	Continental United States
HQ PACAF	Headquarters, Pacific Air Force
ISR	Intelligence, Surveillance, and Reconnaissance
IT	Information Technology
JFACC	Joint Forces Air Component Commander
JFC	Joint Forces Commander
JV 2010	Joint Vision 2010
MOOTW	Military Operations Other Than War
ROSC	Rear Operations Support Center
TACC	Tanker Airlift Control Center
TACS	Tactical Air Control System
TMD	Theater Missile Defense
US	United States

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